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HYDRAULIC PROBLEMS OF LOCAL INTERESTS UNDER THE CENTRAL AND SOUTHERN FLORIDA PROJECT

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INTRODUCTION

Conservation of natural resources has been practiced by the peoples of the earth only during the last few generations. In the 20th Century, this movement to protect, conserve and use most efficiently the resources of nature has gained real momentum. Approximately 20,000 generations of mankind have peopled the earth but the last three or four of these have destroyed much of our natural wealth and beauty. Today, we have awakened to the need for effective conservation.

In a recent talk before the American Planning and Civic Association, Mr. Clayton M. Hoff of the Brandywine Valley Association, Wilmington, Delaware, concluded his remarks with the following:

> "The natural resources are something that God gave you and me to keep in trust, and to pass on to the next generation in at least as good condition as we found them."

With this concept of our temporary stewardship of natural resources, we accept a challenging responsibility for their conservation and improvement in the interest of our children and their children. The cooperative effort of the Federal Government, the states and private citizens everywhere can produce significant improvement of natural resources. Our supply of fresh water for domestic, agricultural, industrial and recreational purposes can be materially improved as a result of this cooperation.

HYDRAULIC PROBLEMS OF LOCAL INTERESTS UNDER THE CENTRAL AND SOUTHERN FLORIDA PROJECT

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The area which is now the State of Florida was one of the first places to be discovered by white men in their early explorations of the Western Hemisphere. The oldest city in the United States, St. Augustine, was established in 1565 by the Spaniards. As recently as 1948, and approximately 400 years after the white man first came to Florida, only seven percent of the land area of this state was under intensive development and cultivation. It is little wonder that the interior of Florida is looked upon as one of the modern frontiers in the agricultural development of the United States.

Fortunately, the Central and Southern Florida Project is showing landowners what can and will be done to control floods and conserve water in this potentially productive area: an area of 15,570 square miles along the eastern side of the Florida Peninsula from Sanford on the north to the Florida Keys on the south. Progress to date on this Federal-State project has stimulated land development in the area during the last three years. Private landowners and the organized drainage districts of central and southern Florida are now keenly aware of the dual problem of protection against flooding and conservation of fresh water, which continuously confronts them in their efforts to obtain maximum production from the lands which they now have under cultivation.

As the other papers of this symposium emphasize, the Central and Southern Florida Project is designed to produce a system of major canals, levees and reservoirs in a 15,000 square mile area of central and southern Florida. This system of major works will be designed so that a high degree of protection against flooding will be afforded the rich agricultural areas and the communities within the project area. In addition, maximum use will be made of the natural lakes and marshes of the area to store and conserve fresh water during the rainy season of each year for later reuse by agriculture, industry and for domestic water supply. Stated very concisely, it may be said that the project will place private lands in the area in a position to enjoy benefits of protection against flooding and conservation of fresh water, provided that the private landowner will construct, maintain and operate, entirely with his own resources, a satisfactory system of water control on his own land. Here, the private landowner is confronted with many problems of hydraulics in carrying out the development of his lands in such a way that maximum benefit of the Central and Southern Florida Project can actually be realized.

The working partnership between the farmer, the soil scientist and the engineer is assuming greater and greater importance in south Florida. The problems of water control are of such importance that the farmer is obliged to give them first consideration even in the decision to purchase a particular tract of land. The time is already upon us in south Florida when a prospective purchase of land requires the services of a competent engineer to assist him in the selection of the tract. The engineer must satisfy himself that an adequate system of water control can be built at reasonable cost on the tract

under consideration. Factors considered by the engineer will include the topography of the area, the location with respect to the major works of the Central and Southern Florida Project, geology of the area, the nearby natural lakes and waterways, existing ground water conditions and the availability of access to natural or artificial channels for flood relief and for irrigation purposes and the adequacy of irrigation supply for the type of agricultural activity being considered by the client.

There is a great variation in topography within the project area. For example, in the north we find rolling country with a mineral soil very porous in character and underlain with impervious strata only at great depths. The region has numerous lakes, some of which have no outlet except through the underground and the maximum elevation of ground surface is approximately 100 feet above sea level. The other extreme of topography is to be found in the Everglades south of Lake Okeechobee, where vast areas of saw grass constitute the wild lands of the Everglades now being converted into a storage area for fresh water by the construction of levees to surround an area of 850,000 acres in Palm Beach, Broward and Dade Counties. In the Everglades area, slopes are extremely flat. For example, the ground elevation in the vicinity of Belle Glade is approximately 15 feet above sea level. The ground elevation in the Miami area is approximately 7 feet above sea level and the distance between these two points is 96 miles. The extremes of topography and soils characteristics in the area of this project are reflected also in the wide variation of runoff factors in various areas of the project area. In the extreme north end of the Kissimmee River Basin, the runoff factor is approximately 10 percent, while in the basin of the Caloosahatchee River, the west side outlet of Lake Okeechobee, the runoff has been computed from discharge measurements to be 47 percent.

The soils of the area have been completely described in numerous publications of the U. S. Soils Conservation Service of the Department of Agriculture, working in cooperation with the Department of Agriculture of the State of Florida. The three principal soils classifications are the mineral or sandy soils of the higher and rolling country of the north end of the project area and of the coastal ridge along the Atlantic Ocean. Second, the organic or muck soils found in the Everglades area, south and southeast of Lake Okeechobee, and in the natural lakes and marshes throughout the area of the District. The third separate and distinct soils classification is the soft rock soil which is produced by pulverizing the natural rock formation found at the surface in large areas of southern Dade County. From these three basic soils, all possible combinations exist within the project area.

From 1916 to 1951, a series of observations, to determine rate and amount of subsidence of the organic soils of the Everglades, have been carried out by the United States Government in cooperation with various agencies of the State of Florida. As a result of these observations, some very valuable data on behavior of organic soils has been obtained. This data was ably summarized in a recent report[1] by John C. Stephens[2] and Lamar Johnson[3]. The principal conclusions, based on these data, are:

a. Rate of soil loss depends mostly upon depth to the water table.

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1. "Subsidence of Peat Soils in the Everglades Region of Florida."
2. Research Project Supervisor, Everglades Project, Soil Conservation Service.
3. Head, Engineering Department, Central and Southern Florida Flood Control District.

b. Under equivalent conditions of drainage, the virgin peat soils subside at a slightly higher rate than cultivated peats.
c. Undeveloped areas of peat in upper "Glades" area are suffering severe subsidence losses.
d. To insure fullest returns from remaining peat soils, an adequate water control system should be developed for the area as rapidly as practicable to maintain optimum water levels and thus insure maximum production of food and fiber at minimum subsidence rates.

In February, 1953, the Central and Southern Florida Flood Control District, the agency of the State of Florida handling local responsibilities under the project, adopted a plan of secondary drainage for the entire 735,000 acres of organic soils, to be included in the protected agricultural area under the Central and Southern Florida Project. This plan provides for the acquisition of right-of-way for secondary canals tributary to the four main canals of the area constructed by the old Everglades Drainage District and now scheduled to be improved and enlarged under the current program. The right-of-way thus acquired by the State will be available to private landowners having no frontage on the major canals and needing access thereto for relief of flooding and to bring irrigation water to their lands during the dry months.

The engineer must design any system of water control on private land to take maximum advantage of the major works of the Central and Southern Florida Project. Consideration must be given to the fluctuations in water level which will occur in the major canals of the system, in order that adequate provision may be made for the removal of flood waters from the land during the rainy season and for the delivery of irrigation water to the land during the dry months of each year. A study of the functioning of the pertinent parts of the system of major works will indicate clearly to the engineer the limits within which he must design the works of his client to function for the benefit of water control on the land.

The natural channels and lakes in the immediate vicinity may figure prominently in any plan of water control which the engineer produces on private lands. A very vital consideration in any plan of water control is the provision of adequate access from the lands under development to the major canals of the Central and Southern Florida Project or to natural waterways which connect therewith.

A study of ground water conditions in lands under development is an important element in any engineering investigation of a comprehensive system of water control. Extensive records exist in the publications of the U. S. Geological Survey of ground water conditions in this area of Florida. Fortunately, this record is being expanded rapidly by the construction of additional stations under the cooperative program, financed jointly by the Central and Southern Florida Flood Control District, the Corps of Engineers and the U. S. Geological Survey. In the very near future, we will have excellent coverage of the entire project area by recording gauges which will maintain a continuing record of ground water levels throughout the district area. Directly related to the problem of ground water on a tract under development are the problems of seepage from adjoining private facilities or from major works of the Central and Southern Florida Project. Certain areas in south Florida will be adversely affected by seepage losses from the reservoirs of the Flood Control Project. Any system of water control must take this factor into account by limiting the use to which these lands are put or by providing adequate interceptor canals or pumping capacity to remove this seepage water.

The design of a system of water control starts from the basic information

on rainfall which is readily available. In addition, we need to have a close approximation of the evapo-transpiration losses throughout the year. Plate I shows the average monthly rainfall for a 26 year period at the Everglades Experiment Station. In addition, a second curve shows the potential evapo-transpiration for the area of Florida by months, as indicated in a recent study[1]. If the monthly rainfall equalled the monthly potential evapo-transpiration throughout the year, the area would not require man made works for water control. Unfortunately, this is not the case and great expense is involved to produce the water control systems which will bring water supply on the land as nearly as possible into balance with potential evapo-transpiration.

Plate I shows that any system of water control to be effective must provide for supply of irrigation water and removal of flood water. Since the rainfall curve reflects average precipitation by months, it fails to tell the entire story. Extremes of drought increase the irrigation requirement while in wet years, a heavy load is placed on the system to remove surplus water.

Farm systems of water control in Florida are more costly to construct than the farm irrigation systems of the Western States because canals and pumping facilities must be sized to handle removal of extremely heavy rainfall of June through October, while the Western systems handle the irrigation requirement only. In addition to handling the situation, as reflected in Plate I, pumping capacity should be provided for the protection of tender vegetable crops to remove 4.5 inches in 24 hours. Most farmers take a calculated risk and provide less than this theoretical capacity. This rainfall represents a storm frequency of once in 5 years during the normal vegetable growing season, November through March.

Plate II[2] illustrates the average monthly rainfall, by bar graph, with the water requirements of a spring and a fall crop of green beans. In the event that rainfall is normal, the crops will require irrigation in the amount represented by the two shaded areas. However, if the 24 hour storm of 5 year frequency should occur, surplus rainfall must be removed quickly from the water-sensitive crop.

In conclusion, I would like to re-emphasize that the hydraulic problems, confronting the private landowner and his engineer in the development of lands for agricultural purposes in central and southern Florida, require careful consideration and adequate solution to insure the success of the farming operation. Proper regard for topography, soils, ground water, geology, natural and artificial waterways and access thereto, and adequacy of irrigation water supply are the major considerations which will influence the engineer's decisions. In reality, the provision of adequate water control on private lands within the area of the Flood Control Project, represents the final step in a long range development, involving the Federal Government, the State of Florida and private citizens working together, to realize maximum possible benefit from our greatest of all natural resources, fresh water.

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1. "Evapo-transpiration in the Hydrologic Cycle," by C. W. Thornthwait, Johns Hopkins University, Laboratory of Climatology.
2. Data from Everglades Experiment Station.

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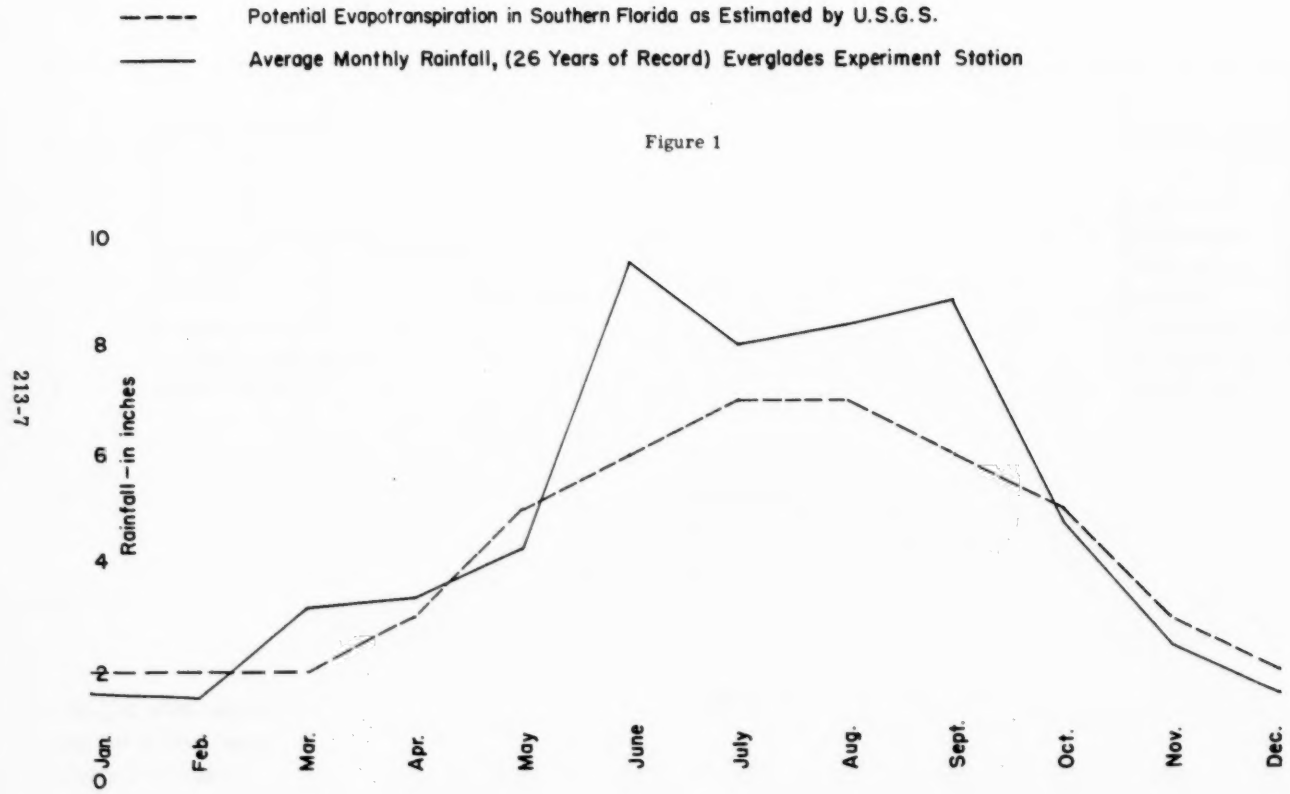
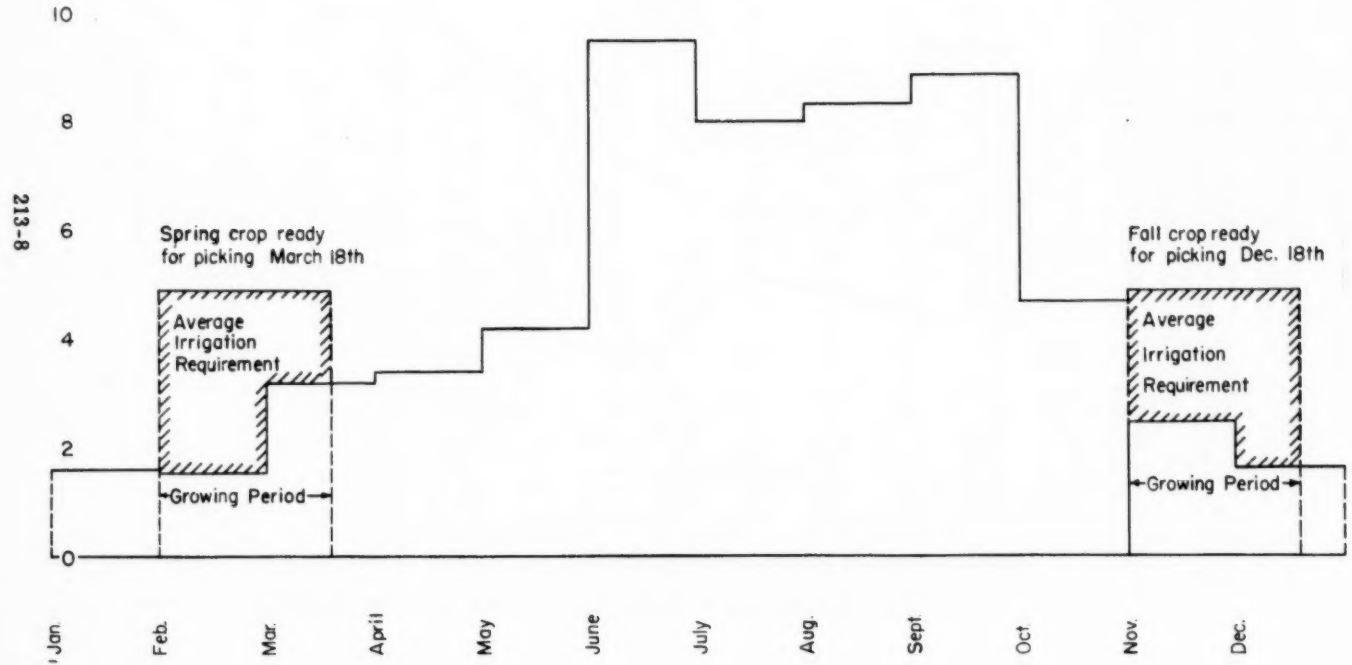

Potential Evapotranspiration in Southern Florida as Estimated by U.S.G.S.
Average Monthly Rainfall, (26 Years of Record) Everglades Experiment Station
Rainfall - in inches
10
8
6
4
2
0
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

Figure 1

Water requirement,
Green bunch beans
48 day growing period
7.87" of water required

Figure 2



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